REMARKS

Claims 1-41 are pending in this application and stand rejected. (Applicant notes that the pending Office Action Summary in line 6 states that claims 1-14 are rejected, but that is believed to be a typographical error.) Claims 1-9, 15-23, 25-26, 28, 30-33, and 36- 39 have been amended in this response. No new matter has been added. Claims 42-54 have been added, without the addition of new matter. Applicant respectfully requests reconsideration of this application and its pending claims in light of the amendments and the following remarks. Applicant first addresses the amendments to the specification and the basis for Examiner's rejection of the claims. Applicant has included a new IDS with this response with a reference that was previously cited in a corresponding foreign patent but, until now, unavailable to Applicant and the last section of this response addresses the teachings of the new reference.

I. In the Specification

No new matter has been added. In paragraph 43, the term "risk-related maps" has been introduced to refer collectively to the probability maps, cutoff maps, and confidence limit maps, described in the specification as filed. The phrase "risk-related maps" has also been used in paragraph 46.

A second substitute specification has been included with this Response.

II. The § 103 Rejections

In the Office Action dated November 14, 2003, the Examiner rejected claims 1-41 under 35 USC 103(a) as being unpatentable.

A. Claim 1

Claim 1 stands rejected under 35 U.S.C. 103(a) as being unpatentable over **Jones** (U.S. Patent No. 5,838,634) in view of **Matteucci** (U.S. Patent No. 5,884,229) and **Tucker** (The Computer Science and Engineering Handbook, edited by Allen B. Tucker, Jr., 1997).

The Examiner states that **Jones** discloses field data (for claim 1's "scattered data observations"), a three dimensional array and "grids" and states that the combination of three-dimensional array and "grids" disclose claim 1's "intersections." Applicant respectfully disagrees but has amended claim 1 to clarify the differences between it and the prior art.

Claim 1 has been amended to recite:

> 1. A method of generating a map illustrating a set of risk-related characteristics of a cross section through an earth formation, representing a time slice passing horizontally through the formation or a horizon passing generally horizontally through said formation, in response to a plurality of scattered data observations on said cross section representing a plurality of parameters located at a plurality of locations on said cross section, comprising the steps of:
>
> (a) gridding said cross section thereby generating a gridded cross section which includes a grid having a plurality of intersection points, wherein each intersection point is not an area and is not a volume, and said plurality of scattered data observations distributed among the intersection points of said grid on said cross section;
>
> (b) obtaining a unique cumulative distribution function associated with each intersection point of the grid of the gridded cross section using ordinary Kriging, thereby producing a plurality of

cumulative distribution functions associated, respectively, with the plurality of intersection points of said grid;

(c) choosing a value representing a probability-related attribute from each of the cumulative distribution function at each of the intersection points of the gridded cross section thereby producing a plurality of values associated, respectively, with the plurality of intersection points, and

(d) assigning each value to its associated intersection point of the gridded cross section and assigning a unique color to said each value thereby generating a map illustrating said set of risk-related characteristics of said cross section through said earth formation.

No new matter has been added. Support for these amendments can be found in the specification as filed. For the limitation of "a map illustrating a set of risk-related characteristics of a cross section," *see e.g.* page 13, lines 4-6 (also in the substituted specification at paragraph 43) "probability maps, cutoff maps, and confidence limit maps..." For the limitation of "a time slice passing horizontally through the formation or a horizon passing generally horizontally through said formation," such a description is inherent in the definition of "time slice" and "horizon," but also disclosed in the figures as filed (see *e.g.* Fig. 4, cross section 36). Intersection points are depicted in Fig 9 as filed (such as intersection 62). The "value" of claim 1 in step c is further described as "representing a probability-related attribute," as disclosed, for example, by Figs 13, 15, 17 and 19. The limitation of "ordinary Kriging" is in claim 2 as filed and is described in the specification as filed.

Applicant agrees that **Jones** discloses forming three-dimensional, geologic block models based on field data. But Applicant respectfully asserts that this is a very

important distinction between Jones and the present invention. In **Jones**, "[d]imensions of the blocks are typically chosen so that the rock properties are relatively homogenous within a block, yet without requiring an excessive number of blocks for the model. ... The objective of a geologic modeling process is to assign rock properties to each block in the geologic model." As claim 1 recites " a map illustrating a set of risk-related characteristics of a cross section through an earth formation," not assigning rock properties to blocks, **Jones** teaches away from the present invention.

Jones describes three types of data used in the modeling process (col. 1, lines 63-64), not to create the structure of the model but specifically "to assign values of the rock properties of interest to all blocks" (col. 2 line 47-49): "Rock property data from wells" (col. 1, line 65), "structural surfaces or horizons in the form of 2D computer grids or meshes" (col. 2, line 10-11) and "stratigraphic surfaces in the form of 2D computer grids or meshes" (col. 2, line s 21-22). In other words, with a careful examination, **Jones** does not describe using "structural surfaces or horizons in the form of 2D computer grids or meshes" as part of a mapping structure, but only as one type of input data used to determine the rock properties of the blocks. (The process of determining rock properties from this input data is further described in Jones at col. 2, line 46 through col. 3, line 24.)

Therefore, Applicant respectfully asserts that the grids used as input data to determine rock properties cannot be combined with the structural three-dimensional blocks disclosed by **Jones** to yield the cross section, grids and intersection points of claim 1, as amended.

Similarly, the field data of **Jones** are used to directly determine rock properties of the blocks and for no other purpose. For example, they are not used by **Jones** to determine the values "representing [] probability-related attribute[s]," as recited in claim 1.

Nor does **Jones** disclose " a map illustrating a set of risk-related characteristics of a cross section through an earth formation, representing a time slice passing horizontally through the formation or a horizon passing generally horizontally through said formation," as recited by claim 1 as amended. The Examiner has agreed that Jones does not disclose the remaining limitations of claim 1.

The Examiner cites **Matteucci** as disclosing "investigating properties of the plurality of scattered data observations distributed among the intersections of the grid by obtaining a unique cumulative distribution function." (As the Examiner asserted that the first part of this clause did not further limit the claim, it has been deleted.) Applicant agrees that **Matteucci** discloses use of a cumulative distribution function, but such use is disclosed only in the context of comparing the amplitude of seismic traces. Specifically, **Matteucci** discloses the use of a cumulative distribution function to measure "the similarly of the amplitude distributions of the two seismic traces." **Matteucci** at col. 6, lines 58-60. **Matteucci** discloses taking the cumulative distribution function of one trace (say the reference trace), subtracting the cumulative distribution function of another trace, and taking the maximum value of the absolute difference to calculate the Kolmogrov-Smirnov statistic, D (see Matteucci at column 6, line 58-column 7, line 16), which "measures the similarity of the amplitude distribution of the two seismic traces." **Matteucci** uses cumulative distribution functions to measure the similarity of the amplitudes of two vertical curves, not to make a statistical analysis of data on a two

dimensional plane such as the cross section of the present invention to determine a value "representing a probability-related attribute" at an intersection point.

Matteucci does not disclose "a set of risk-related characteristics of a cross section through an earth formation..."**Matteucci** also does not disclose" representing a time slice passing horizontally through the formation or a horizon passing generally horizontally through said formation" as recited in claim 1 as amended. Whether a seismic trace is considered purely vertical or not, such a trace is not a "horizontal" or "generally horizontal" and is not a two-dimensional surface such as a time slice or a horizon: it is a generally vertical, one-dimensional line having amplitudes (which is not a spatial dimension). It is also not an intersection point. **Matteucci** does not disclose "a value representing a probability-related attribute from each of the cumulative distribution function at each of the intersection points," as recited by claim 1.

The Examiner questioned whether the intersections of the present invention were points, areas or volumes. The intersections of the present invention cannot be volumes as they are intersections of a grid of lines on a time slice or horizon. Intersections of two (non-parallel) lines are points. Points do not have areas or volumes. As displayed or drawn, of course, the representations of the intersection points would have three dimensions as they are in the real world, just like any graphs or other representations of mathematical objects in the real world. So the ink dot representing a point on a printed or drawn map would have a certain area and thickness, and a pixel representing an intersection point would have an area on a display screen. But the ink dots and pixels are representations of the intersections, not the intersections themselves, which do not have area or volume.

Applicant respectfully suggests that Examiner's reconstruction of the present invention with **Jones** and **Matteucci** does involve impermissible hindsight. In an effort to define what constitutes a *prima facie* case of unpatentability in a 35 USC 103 rejection, Section 706.02(j) of the 'Manual of Patent Examining Procedure (MPEP)' sets out the contents of a 35 U.S.C. 103 rejection and sets forth the requirements for making a '*prima facie*' case of obviousness:

> "To establish a *prima facie* case of obviousness, three basic criteria must be met. First, **there must be some suggestion or motivation**, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, **to modify the reference or to combine reference teachings**. Second, **there must be a reasonable expectation of success**. Finally, **the prior art reference** (or references when combined) **must teach or suggest all the claim limitations**."

MPEP 706.02(j) (emphasis added).

In the same section, the manual states:

> "The initial burden is on the Examiner to provide some suggestion of the desirability of doing what the inventor has done."
>
> "Because the Board did not explain the specific understanding or principle within the knowledge of a skilled artisan that would motivate one with no knowledge of Rouffet's invention to make the combination, this court infers that the examiner selected these references with the assistance of hindsight. This court forbids the use of hindsight in the selection of references that comprise the case of obviousness. See In Re Gorman, 933 F 2d 982, 986, 18 USPQ 2nd (BNA) 1885, 1888 (Fed Cir 1991). Lacking a motivation to combine references, the Board did not show a proper prima facie case of obviousness. This court reverses the rejection over the combination of King, Rosen, and Ruddy."

In Re Roufett, 149 F 3rd 1350, 47 USPQ 2nd 1453, 1458 (Fed Cir 1998). Although Examiner has stated "Matteucci's cumulative distribution functions are a standard tool for manipulating experimental data to 'assign values of rock properties of interest to all blocks within the geologic model...," the Examiner has provided no motivation within the references or outside them do so, nor has there been shown any motivation to apply such an analysis to choose "a value representing a probability-related attribute from each of the cumulative distribution functions at each of the intersection points of the gridded cross section," as recited by claim 1.

Even such a combination of references would not result in all the limitations of claim 1. To properly combine **Jones** and **Matteucci** would yield a result with three dimensional blocks defined for a subsurface volume. The rock properties of the blocks would be determined by field data. Seismic traces would pass vertically through the blocks, with cumulative distribution functions being taken to compare the amplitudes of the seismic traces, to determine their similarity.

Cumulative distribution functions would not be taken of the field data, as there is no suggestion within **Matteucci** or **Jones** to do such a thing, and such cumulative distribution functions of field data would not be taken around intersections on a horizontal grid as no such structure is disclosed in **Jones** or **Matteucci**. No risk-related characteristic would be mapped as no such characteristics are disclosed by the references.

Nor does **Tucker** supply the deficiencies of **Jones** and **Matteucci**. While **Tucker** does disclose the use of color in "a particular slice of 3-D dataset," it does not disclose the use of color as recited in claim 1, that is. assigned to a value taken from the cumulative distribution function of an intersection on the grid of the cross section.

Combining **Jones**, **Matteucci** and **Tucker** would result in a 3-D cube array or block. The array would have a plurality of seismic traces passing vertically through it and the combination would involve an analysis of the similarity of seismic traces using cumulative distribution functions and Kolmogorov-Smirnov statistics, with similar seismic traces being assigned similar colors.

Thus claim 1 as amended is felt to distinguish patentably over the combination of the **Jones**, **Matteucci** and **Tucker** references.

B. Claims 2-14

Claims 2-8 have been amended to clarify that the intersections of the instant invention are points. As with respect to claim 1 in this regard, no new matter has been added. In addition, claims 3-7 have been amended to clarify and give greater detail for the steps of the methods claimed. Support for these amendments is found in the specification as filed, for example, at page 14 line 30 – page 17, line 8.

Claims 2 through 14 depend directly or indirectly from claim 1 and contain all of its limitations.

The additions of other cited references, **Hogg** and **Journal**, do not supply the deficiencies of **Jones**, **Matteucci** and **Tucker** with respect to these claims. For example, with respect to claim 2, the Examiner states that Kriging and probability functions are disclosed by **Journal** as described in the instant Specification, but the use of such tools as recited by claim 2 in connection with being taken at and corresponding to intersections of the gridded cross section is not disclosed by **Journal**. While the Examiner asserts that it would be obvious to combine the cited references to achieve claim 2, no motivation for such a combination has been shown in the references. This could only be done, if at all,

with an impermissible use of hindsight. Without the benefit of hindsight, such a **Jones-Matteucci-Tucker-Journal** would result in a 3-D cube array or block. The array would have a plurality of seismic traces passing vertically through it and the combination would involve an analysis of the similarity of seismic traces using Kriging or the traces, calculating probability distribution functions of the traces, taking cumulative distribution functions and Kolmogorov-Smirnov statistics for the traces, with similar seismic traces being assigned similar colors. This combination would still fail to achieve the limitations of claim 2.

Nor does **Hogg** supply the deficiencies of the other references. With reference to clam 3, for example, **Hogg** does not disclose the application of the statistical tool of choosing a probability from the cumulative distribution function in the circumstance where the cumulative distribution function is taken at an intersection of a grid on a gridded cross section. Such an application is not disclosed by **Hogg**, which does not supply the deficiencies of the previously discussed references.

In addition, **Webber** has been cited against claims 8 and 9. **Webber** does not supply the deficiencies of the previously discussed references. While it does, as the Examiner points out, disclose the use of affine correction, it is in the context of the transformation of three dimensional matrix volumes and does not disclose "applying an affine correction to each of the values chosen from each of the cumulative distribution functions associated with each of the intersections of the gridded cross section" as recited by claim 8. (Claim 9 depends from claim 8 and is likewise patentably distinguishable over the cited references.)

Accordingly, claims 2-14 are felt to be patentably distinguishable from the cited references and are believed to be condition for allowance.

C. Claim 15

Claim 15 stands rejected under 35 U.S.C. 103(a) as being unpatentable over **Jones** in view of **Matteucci** and **Tucker,** for the reasons described with respect to claim 1. Claim 15 has been amended in a manner similar to the amendments made to claim 1. As with the amendments to claim 1, no new matter has been added. Claim 15 is an independent "Program storage device ... cross section claim" with limitations corresponding to those of claim 1. Therefore, for the reasons set forth above with respect to claim 1, claim 15 is felt to be patentably distinguishable from the cited references and is believed to be in condition for allowance.

D. Claims 16-24

Claims 16-24 have been amended to clarify that the intersections of the instant invention are points. As with respect to claim 15 in this regard, no new matter has been added. In addition, claims 17-21 have been amended to clarify and give greater detail for the steps of the methods claimed. Support for these amendments is found in the specification as filed, for example, at page 14 line 30 – page 17, line 8.

Claims 16 through 24 depend directly or indirectly from claim 15 and contain all of its limitations. The additions of other cited references, **Hogg, Journal**, and **Webber** do not supply the deficiencies of **Jones**, **Matteucci** and **Tucker,** for the reasons described above with respect to claims 2-14. Accordingly, claims 16-24 are felt to be patentably distinguishable from the cited references and are believed to be condition for allowance.

E. Claim 25

Claim 25 stands rejected under 35 U.S.C. 103(a) as being unpatentable over **Jones** in view of **Matteucci** and **Tucker,** for the reasons described with respect to claim 1. Claim 25 has been amended in a manner similar to the amendments made to claim 1 and claim 15. As with the amendments to claim 1 and claim 15, no new matter has been added. Claim 25 is an independent "apparatus adapted for generating a risk-related map representing a cross section" claim with limitations corresponding to those of claim 1 and 15. Therefore, for the reasons set forth above with respect to claim 1, claim 25 is felt to be patentably distinguishable from the cited references and is believed to be in condition for allowance.

F. **Claims 26-29**

Claims 26-29 have been amended to clarify that the intersections of the instant invention are points. As with respect to claim 25 in this regard, no new matter has been added.

Claims 26 through 29 depend directly or indirectly from claim 25 and contain all of its limitations. The additions of other cited references, **Hogg, Journal**, and **Webber** do not supply the deficiencies of **Jones**, **Matteucci** and **Tucker**. Accordingly, claims 26-29 are felt to be patentably distinguishable from the cited references and are believed to be condition for allowance.

G. Claim 30

Claim 30 stands rejected under 35 U.S.C. 103(a) as being unpatentable over **Jones** in view of **Matteucci** and **Tucker,** for the reasons described with respect to claim 1. Claim 30 has been amended in a manner similar to the amendments made to claim 1,

claim 15 and claim 25. As with the amendments to claims 1, 15 and 25, no new matter has been added. Claim 30 is an independent "method of generating a cube illustrating a set of risk-related characteristics of an earth formation" claim with limitations corresponding to those of claims 1, 15 and 25. Therefore, for the reasons set forth above with respect to claim 1, claim 30 is felt to be patentably distinguishable from the cited references and is believed to be in condition for allowance.

H. Claims 31-35

Claims 31-35 have been amended to clarify that the intersections of the instant invention are points. As with respect to claim 30 in this regard, no new matter has been added.

Claims 31 through 35 depend directly or indirectly from claim 30 and contain all of its limitations. The additions of other cited references, **Hogg**, **Journal**, and **Webber** do not supply the deficiencies of **Jones**, **Matteucci** and **Tucker**. Accordingly, claims 31-35 are felt to be patentably distinguishable from the cited references and are believed to be condition for allowance.

I. Claim 36

Claim 36 stands rejected under 35 U.S.C. 103(a) as being unpatentable over **Jones** in view of **Matteucci** and **Tucker,** for the reasons described with respect to claim 1. Claim 36 has been amended in a manner similar to the amendments made to claim 1, claim 15, claim 25 and claim 30. As with the amendments to claims 1, 15, 25 and 30, no new matter has been added. Claim 36 is an independent "program storage device ...for generating a cube illustrating a set of risk-related characteristics of an earth formation"

claim with limitations corresponding to those of claims 1, 15, 25 and 30. Therefore, for the reasons set forth above with respect to claim 1, claim 36 is felt to be patentably distinguishable from the cited references and is believed to be in condition for allowance.

J. Claim 37-41

Claims 37-41 have been amended to clarify that the intersections of the instant invention are points. As with respect to claim 36 in this regard, no new matter has been added.

Claims 37 through 41 depend directly or indirectly from claim 36 and contain all of its limitations. The additions of other cited references, **Hogg**, **Journal**, and **Webber** do not supply the deficiencies of **Jones**, **Matteucci** and **Tucker**. Accordingly, claims 37-41 are felt to be patentably distinguishable from the cited references and are believed to be condition for allowance.

K. New Claims 42-56

New claims 42-46 depend from claim 25 and contain all of its limitations. No new matter has been added. Support for these claims is found at claim 25 as filed and in the specification as filed, for example, at page 14 line 30 – page 17, line 8. Accordingly, claims 42-46 are felt to be patentably distinguishable from the cited references and are believed to be condition for allowance.

New claims 47- 51 depend from claim 30 and contain all of its limitations. No new matter has been added. Support for these claims is found at claim 30 as filed and in the specification as filed, for example, at page 14 line 30 – page 17, line 8. Accordingly,

claims 47-51 are felt to be patentably distinguishable from the cited references and are believed to be condition for allowance.

New claims 52-56 depend from claim 36 and contain all of its limitations. No new matter has been added. Support for these claims is found at claim 36 as filed and in the specification as filed, for example, at page 14 line 30 – page 17, line 8. Accordingly, claims 51-56 are felt to be patentably distinguishable from the cited references and are believed to be condition for allowance.

II. Additional Reference: Colin et al.

Applicant has successfully obtained a copy of a previous cited but unavailable reference "Integrating Geophysical Data for Mapping the Contamination of Industrial Sites by Polycyclic Aromatic Hydrocarbons: A Geostatistical Approach" by Colin, P. et al ("**Colin**"), ASTM Special Technical Publication no. 1283, October 1996, pp. 69-87. A copy is enclosed with this response.

The reference presents a "case study ... of building a map showing probability that the concentration of polycyclic aromatic hydrocarbon (PAH)" a potentially carcinogenic pollutant, " exceeds a critical threshold." Abstract at page 69.

Colin uses hydrocarbon samples and resistivity logs as sources of data. (See **Colin**, last line of page 74-page 76. Such data could be used in the present invention.

Colin uses a geostatistical method, specifically simulated annealing and simple indicator Kriging. (see the section beginning on page 77, entitled "Building the Probabilistic Model," continuing through page 78. The present invention also uses a geostatistical method, but uses "ordinary Kriging" as recited in claim 1 as amended (for example) of the present application. (Other independent claims as amended also recite

Kriging.) This is a more important distinction than it would appear at first glance. **Colin** uses a simulated annealing technique to fill the space with estimates and then uses indicator Kriging and a probabilistic model to derive a range of possible values at each node of the grid. The present invention, a recited in claim 1 for example, performs this in one step by using ordinary Kriging. Ordinary Kriging uses a Gaussian model and determines the cumulative distribution function. This would be an improvement over the method disclosed by **Colin** as the present invention is simpler and would also be cheaper and quicker. The method of the present invention requires only the assumption of normal distribution, and does not require special features.

But that is not the only difference between the method described by Colin and that of the present invention. The product of the present invention would be more accurate than that disclosed by **Colin**. The results of the present invention would be *different and more correct*, because simulated annealing requires a model or target as well as a desired closeness of fit defined by the user. This has the disadvantage that the user can make the answer become anything the user wants. Furthermore, indicator Kriging uses a restricted number of histogram slots (a typical value would be, say, five). This would mean that one can only have maps for any one of those five cutoffs. With the standard Kriging of the present invention, the product has a continuous range of values, providing for more precision that would result with the indicator Kriging of **Colin.**

While **Colin** does disclose a probability map, it is only for a critical threshold of the pollutant. The instant invention can produce at least five different types of probability maps: compare claims 3- 7 as amended of the instant application. Colin would disclose only the upper limits, such as is recited in claim 6.

Because of the differences between the method disclosed by **Colin** and the instant invention as recited in claim 1, Applicant believes that even if Colin were combined with the other references, the combination would not yield the limitations of the present invention as recited in claim1 and the other independent claims of the present invention. Accordingly, Applicant respectfully submits that the present claims are patentably distinct over the references, including **Colin**, and are in condition for allowance.

CONCLUSION

Applicants respectfully request reconsideration of this application and allowance of its pending and new claims.

Respectfully submitted,

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Enclosures:

1. Acknowledgment Postcard
2. Transmittal Form
3. Petition for Extension of Time and Authorization to Charge Deposit Account (in duplicate)
4. Information Disclosure Statement (1 reference)